

Laboratory-scale studies on smart gypsum composite boards incorporated with nano-encapsulated organic phase change material for thermal comfort building application

ABSTRACT

An experimental study is presented examining the preparation and characterization of a smart gypsum composite board for thermal comfort building application. Composite boards were prepared by mixing 1-30% by weight nano-encapsulated n-octadecane phase change material (PCM) with gypsum to develop gypsum-based building materials with thermal energy storage (TES) capability. The nanocapsules were prepared by encapsulating n-octadecane in nano-sized styrene-methyl-methacrylate copolymer shells using one-step mini-emulsion in situ polymerization. A thermal performance testing device was designed to evaluate the heat storage effect of the resulting gypsum composite. The results indicated that composite boards containing n-octadecane nanocapsules effectively decreased the temperature peak of the experimental test room compared with gypsum board without n-octadecane nanocapsules. This suggested that the composite boards had good thermal energy storage properties. It was also demonstrated that the composite boards containing n-octadecane nanocapsules could be used as a smart heat storage medium for thermal comfort building application. From the thermal properties point of view, incorporating 10% by weight n-octadecane nanocapsules in gypsum was more beneficial than adding more than 10% by weight.

Keyword: Building material; n-Octadecane nanocapsules; Phase change material; Smart gypsum; Thermal energy storage; Thermal properties